4207 West Mercer Way:

Critical Areas Compliance and Mitigation Plan

Vaney-Shinde Residence

Owner:

Rahul Shinde and PashmiVaney
4207 West Mercer Way
Mercer Island, WA 98040

Prepared by:

WR Consulting, Inc.
3611 45th Ave W.
Seattle, WA 98199
Contact: John W. Rundall, P.E.

July 10, 2020
Project No. 20016

A) PROJECT DESCRIPTION

The proposed improvements consist of the construction of a house to replace and existing structure at the north end of the property. See aerial photo (Figure 1) below:

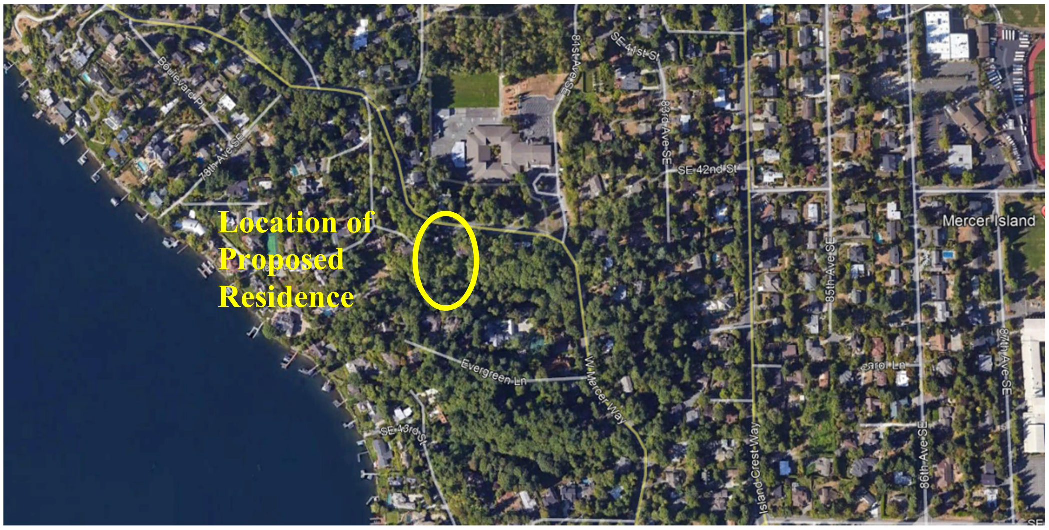

Figure 1 - Project Location

<u>Project Address:</u>

4207 West Mercer Way
Mercer Island, WA 98040

B) CRITICAL AREAS

There are two critical areas present on the site which will be addressed by this memorandum. They are 1) watercourse buffer and 2) geologically hazardous slopes. The water course buffer is defined as a 60 foot wide buffer from the edge of the water course which in this case is located on the adjoining property. The geologically hazardous designation is for areas susceptible to erosion, sliding, earthquake, or other geological events based on a combination of slope (gradient or aspect), soils, geologic material, hydrology, vegetation, or alterations, including landslide hazard areas, erosion hazard areas and . A geotechnical report has been prepared for the project which addresses these issues. This memorandum will focus primarily, but not exclusively on the watercourse buffer impacts and mitigation.

C) EXISTING SOILS

Based on the USGS Soils map, the site is predominantly underlain by Kitsap silt loam (KpD) soils (see map below) which is a Type D soil. A small portion at the north end of the site is mapped as KpB which is the same material as KpD, but it characterized by flatter slopes. The flatter areas at the north end of the site appear to have been created by grading for the roadway and building pad, so the current condition does not reflect the underlying or original soil classification.

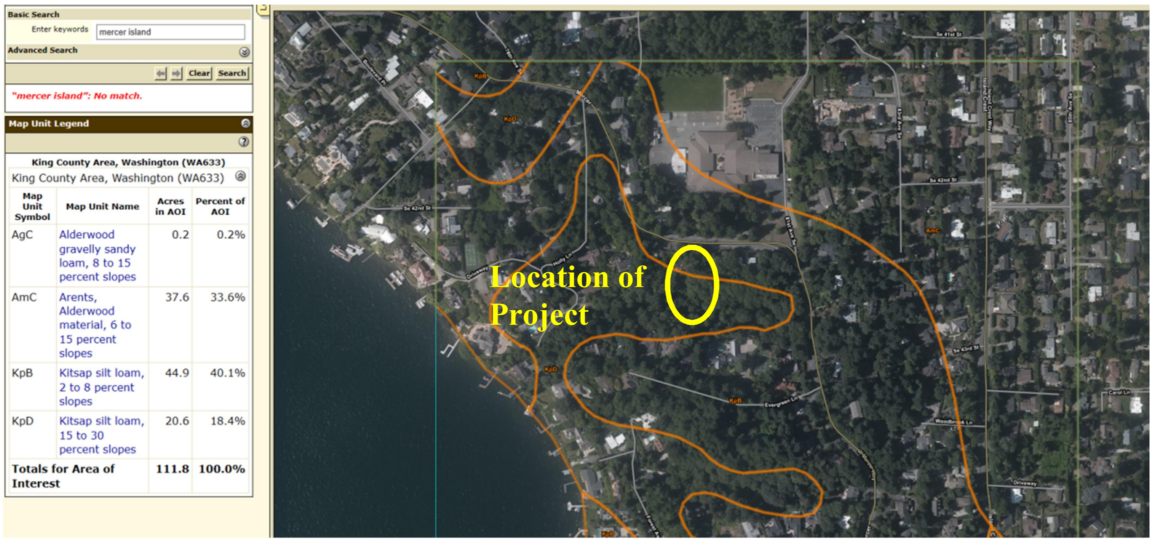

Figure 2 – Soils Map

D) EXISTING PIPING AND OUTFALL

The current outfall consist of a 4"diameter corrugated pipe that is nearly 20 years old. At that age, the pipe becomes brittle and is subject to failure due to impact, joint separation, animals and plugging. Maintenance is made difficult by the corrugations and their tendency to break or puncture when subjected to mechanical or rodding cleaning techniques. The risk of failure is significant because water discharged on the steep slope could lead to instability (either small scale sloughs or larger slides) and result in significant erosion and movement of debris. Sediment from the erosion or earth movement would likely migrate to the water course and cause adverse impacts to benthic invertebrates as well as potentially plugging facilities downstream.

Although there is no form of energy dissipation or erosion control measures at the current pipe outlet, the flows are low enough that it does not appear to be a problem. However, there is still some risk of erosion from an extreme event. A review of the existing pipe outfall shows some minor incision (approx. 12") at the end of the pipe. The area is wet with seepage and soft soils throughout. The established plant cover appears to help stabilize the area and prevent significant erosion, so in spite of the local erosion, the area appears to be stable.

Upgrading the pipe would address any concerns of failure due to the aged facility. The proposed solid wall HDPE pipe is much stronger and the butt-fusion construction means there are no joints that could potentially separate if there is any localized sloughing or slippage. A new pipe would also perform much better in terms of a tree fall or other impact to it. It is expected that a tree falling on the outfall may not even collapse the pipe completely and it would continue to function. Removing the object would allow the pipe to rebound and return to its normal function.

The proposed HDPE configuration also is anchored at the top of slope above the proposed house structure. This adds to the stability of the anchor which is intended to support the weight of the pipe filled with water and withstand localized slippage or sloughing. The butt fused pipe joints are as strong if not stronger than the pipe wall, so the risk of separation at the joints is substantially reduced.

Replacement of the pipe discharge with a more robust outfall and effective spreader configuration would provide a benefit by reducing the risk of erosion from base flows and extreme events. The installation of the detention facility will significantly reduce the risk of extreme event flows and help attenuate flows discharging to the buffer and water course.

E) OPTIONS FOR AVOIDANCE

The geologically hazardous aspects of the building construction are addressed using a number of strategies. The key elements are 1) constructing the new house at the same location as the existing structure, 2) utilizing the relatively flat area at the north end of the site for the new construction and 3) employing significant structural elements to stabilize the slope and support the structure. The primary structural elements include augur cast piles and pin pile supported foundations. Secondary measures include collection of stormwater runoff for conveyance and disposal and slope stabilization measures including mulch and plant restoration. In addition to restoration, the construction BMP of minimizing ground disturbance will also be employed on this project.

Opportunities for alternative options to avoid impacts to the watercourse buffer are limited. However, the option to discharge stormwater to the City storm drainage system on West Mercer Way was reviewed and evaluated. The purpose of the evaluation was to explore alternatives to the existing outfall pipe that currently discharges into the watercourse buffer and determine if they were feasible. This existing 4" diameter corrugated pipe is aged (nearly 20 years old) and has become brittle and is subject to failure. Maintenance is made difficult by to the corrugations and their tendency to break or puncture when subjected to mechanical or rodding cleaning techniques, so eliminating these vulnerable elements will be a benefit to the site.

Since West Mercer Street is above the proposed construction area and detention tank outlet, runoff from the site would need to be pumped up to it. Furthermore, the storm drain in the street does not extend to the property, so approximately 200 feet of new storm drain in the Public Right of Way would be needed to connect to the existing system. The construction of this storm drain extension would disrupt traffic, create safety risks for pedestrians and bicyclists and would add considerable expense to the project.

The pumping facility would require a redundant pump (duplex) configuration with an emergency power backup to maintain service during power outages. This pumped stormwater would ultimately discharge to the same water course so a detention facility would still be required. There would be no less impact to the water course with the West Mercer connection in terms of flow. Although this alternative system has not been designed, our review of the option indicates that it would be much more expensive than the proposed replacement outfall. It also has the added burden of regular maintenance of the mechanical facility and the energy requirement of pumping stormwater for the lifetime of the facility. A gravity solution is a much more reliable and sustainable approach compared to the pumped system.

F) CONSTRUCTION IMPACTS

The proposed outfall pipe and outlet configuration is intended to minimized construction impacts on the steep slope and in the water course buffer. The pipe sections will be fused at the top of the slope and mechanical equipment will lower the continuous section of pipe down the slope. The weight of the pipe is generally enough to pull the section of pipe into place with workers on foot guiding the alignment and heavy equipment at the top restraining the movement. When the pipe has extended to the intended outfall location, it will be permanently anchored to the CB and gravity block at the top of the slope.

Parts for the level spreader outlet tee including fittings, pipe spools, caps, quarry spalls, guide posts and the timber spreader components will all be hand-carried down the slope and assembled in place. This will be accomplished with a minimum of disruption to the water course buffer and any impacts will be addressed by the restoration plans.

F) OUTFALL PIPING DESIGN

The proposed detention tank outfall is HDPE solid wall pipe that will be installed on the surface to convey stormwater to the base of the ravine and discharge into the existing drainage course. The detention pipe storage provides an added measure of protection to the slope and water course buffer by significantly reducing peak flows. Although the release rate of the detention tank is very low, the outfall piping was sized for a 100 year flow rate using the Rational Method. The excess pipe capacity provides also helps protect the hazardous slope by providing a factor of safety for extreme events and reduces the risk of any system overflow downslope.

The outfall pipe strength (DR 9) was selected based on the criteria of supporting the pipe by gravity anchor at the top of the slope. The three main aspects of sizing the outfall are 1) size of the gravity anchor block, selecting the wall thickness to withstand the maximum water pressure in the pipe and selecting the wall thickness to support the weight of the pipe and contents. For all three aspects, the pipe is assumed to be full of water and any other restraining forces such as friction along the soil or soil on the slope supporting a portion of the weight are neglected. There are no pipe anchors other than the gravity anchor at the top of the slope on the north side of the house.

The calculations show the weight of the pipe full of water is on the order of 1,700 lb and the concrete block (3' x 2' x 2') is approximately 1,900 lb which provides a factor of safety of over 1.1. This is accepted because of all of the other factors such as skin friction, distribution of the weight along the pipe, weight of the CB, etc. which provide additional factors of safety toward restraining the pipe. The maximum internal pressure is calculated at 50 psi based on the hydrostatic pressure of the pipe full of water which is much less than the 250 psi rating on the pipe.

The maximum tensile force on the pipe from the weight of the pipe full of water is calculated at 226 psi which is less that the rating of the pipe (250 psi) with a sidewall thickness of DR 9. Pipe anchors are not intended because if there is any ground moving or sloughing in the area, the pipe is expected to remain in place and the soil to move below it. Anchors would add the force of the soil to the pipe which could create significant and potentially destructive stress on the pipe. These measures have been employed to reduce the risk of failure of the pipe and protect the steep slope and water course buffer from damage resulting from .that failure.

The outfall sizing is somewhat arbitrary but the length as selected disperses the flow from the outlet over an area twenty times the width of the dispersion of the existing 4" diameter outlet pipe. Since the existing outfall does not appear to be causing any stability or erosion problems currently, this proposed improvement is expected to maintain soil stability at the out fall, prevent erosion and help new plantings become established. These components include the outfall tee/spreader and the adjacent plant restoration.

After the detention pipe has significantly reduced the peak flow, the water draining down the pipe on the steep slope will add energy that could be erosive if it is not dissipated by the outlet structure. The following will describe in detail how the assembly dissipates the energy and protects the water course buffer. The outlet structure includes the tee which distributes the flow over a wide area (approx. 10 feet), quarry spall pad, notched spreader board and plant restoration. The tee is the first element in the assembly that will dissipate energy of the water by forcing it to change direction and create turbulence within the pipe. Water will then flow out of multiple orifices which will result in very low fluid velocity at the point of discharge. The water will fall out of these orifices onto the quarry spall pad which will further reduce the velocity. The rock also creates more turbulence and the rough or uneven surface will prevent the water from maintaining any velocity.

The notched spreader board will provide an added layer of control by forcing water to be spread out from the pad by the widely spaced notches. Similar to the multiple orifices, the notches will keep the flow velocity low enough to prevent any erosion. The plantings and mulch will provide additional stabilization from the roots binding the soil and the mulch providing a protective and stabilizing layer. In summary all of these components contribute the following functions 1) reduce erosive velocities of flowing water (outlet tee, pad and notched spreader) to prevent the erosive effect of moving water, 2) protect the soil surface and minimize sediment transport (quarry spall pad and mulch layer) and 3) trap or stabilize sediment (plantings and mulch) to prevent migration into the nearby water course.

The main long-term impact to the water course buffer will be the placement of the quarry spall pad which will temporarily cover a small portion of the buffer with imported rock material. It is expected, that this pad will quickly be covered by falling leaves, moss and other detritus that is abundant in a forest setting. The Geotechnical Engineer has prepared a letter outlining the potential impacts of the outfall at this location and addresses the requirements for an outfall on a slope exceeding 15% grade. A copy of this letter is in Appendix A.

A copy of the Small Project Stormwater Report prepared for the project is included as Appendix B in this document. It shows additional details of the construction, erosion control and plant restoration for the project.

G) MITIGATION/RESTORATION PLAN

Although the installation of the downslope piping will have very little impact on the slope or buffer, the outlet spreader construction will create some temporary disruption. The pipe will be black and will quickly be covered by leaf litter, forest detritus and plant growth. Similar to the existing outfall piping (even though much of it is white), after a few years, the new pipe will not be visible. The HDPE pipe material is inert and there are no coatings or other materials that will slough or peel of the pipe, so that aspect has no impact on the water course buffer. It will not present an obstruction to movement of animals typically found in that environment and plants will readily grow near and over it as noted above.

At the proposed outlet location, the site is overgrown with English ivy, Japanese knotweed and Himalayan blackberries, all invasive species of plants. In order to access this outfall construction site, at the toe of the slope, a 20 foot wide zone 10 feet on either side of the pipe (approx. 450 square feet) will be cleared and the weeds removed. Temporary erosion measures will be implemented including wattles, arborist's mulch and plastic sheeting. These BMPs will protect the steep slope and water course buffer a number of ways. The measures will 1) prevent the erosive effect of moving water by covering the exposed soil (plastic sheeting and mulch), 2) reduce erosive velocities of flowing water (wattles and mulch) to minimize the risk of sediment transport and 3) trap or stabilize sediment (wattles and mulch) to prevent migration into the nearby water course.

The long term stabilization will include planting native species of shrubs and other understory plantings in this 450 square foot area around the outfall. These plants will planted at 30" on center, triangular spacing, as detailed on the plans

H) MONITORING PLAN

The proposed monitoring program will consist of a visual inspection of the site by the owner one (1) year after the installation is complete and again two (2) years after completion. They will check for 1) invasive plant growth, 2) establishment of restoration planting and 3) any signs of erosion.

The storm drain outfall should be inspected every year to make sure it is functioning properly and to clear any debris that may be accumulating. They should also check for any signs of erosion, pipe leakage or any indication of sediment transport or migration. The review of the storm drain outfall will be an opportunity to check the restoration of the water course buffer.

The following table outlines tasks and review elements that are needed for the Monitory Plan for this project.

Item	Action	Frequency
Downslope Pipe	Visual Inspection: Check for leaks, erosion, objects falling across the pipe, and confirm it is functioning properly.	Annually or after significant rainfall or wind event that could lead to downed trees.
Outfall Tee and Outlet Pipe	Visual Inspection: Check for plugging, obstructions to holes and even flow to the Quarry Spall pad.	Annually, or as indicated in the Small Project Stormwater Report.
Quarry Spall Pad and Notched Spreader	Visual Inspection: Check for erosion, plugging; confirm even distribution of flow from the Spreader.	Annually, or as indicated in the Small Project Stormwater Report.
Restoration Area below Spreader	Visual Inspection: Check for erosion, exposed earth or other signs of sediment transport.	Annually, or as indicated in the Small Project Stormwater Report.
Plant Restoration	Visual Inspection with photographic documentation: Check for plant mortality and encroachment of invasive plants. Replace any plants exceeding 25% mortality. Remove encroaching invasive weeds.	Annually for a Two Year Period following Completion
Mulch Cover	Visual Inspection with photographic documentation: Check for mulch cover and erosion. Replace mulch in areas with exposed soil or any sign of erosion.	Annually for a One Year Period following Completion

Appendix A

Letter from Geotechnical Engineer Regarding Outlet Stability

Appendix B

Small Project Stormwater Report